Human-Caused Wildfires in Oregon, USA: Utilizing GIS Techniques and Administrative Boundary Data

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Abstract

Humans-initiated wildfires (HIOs) are one of the leading causes of wildfires in the world, threatening ecosystems, communities and economies around the globe, including in the United States of America (USA). As human-induced wildfires become more frequent and severe, they require more in-depth analysis and effective mitigation and management strategies. In this study, we explore the human-initiated wildfire dynamics in Oregon using GIS (Geographic Information System) techniques as well as administrative boundary data. We analyse the spatial distribution of wildfires, temporal patterns and contributing factors to human-induced wildfires in Oregon, with the goal of providing evidence-based mitigation and management recommendations. By combining literature and spatial and temporal analyses, this study provides valuable insights into human-induced wildfire dynamics in Oregon. Our findings highlight the need for proactive measures, collaboration and interdisciplinary wildfire management approaches. As we move forward, further research and evaluation will be critical to improve wildfire preparedness, resilience and mitigation.

Keywords: Human-caused wildfires, Oregon, USA, Geographic Information System (GIS), spatial analysis, temporal analysis, wildfire management, mitigation strategies, administrative

boundary data, interdisciplinary approach, collaborative partnerships, ecosystem resilience, community engagement, and evidence-based recommendations.

1 Introduction

Wildfires caused by human activity are a major threat to ecosystems, communities and economies around the world, including Oregon, USA. The increasing frequency and severity of these wildfires highlights the need for thorough analysis and effective management plans. According to recent Oregon Department of Forestry reports, human activities (campfires, debris burning and equipment use) account for approximately one-third of all wildfire ignitions in Oregon. The spatial distribution, timing patterns and factors that contribute to these wildfires vary from region to region in Oregon, and are influenced by climate, land use and human activity. In Oregon, wildfire management is a complex and multi-faceted problem that requires a comprehensive approach that integrates scientific research, policy and community involvement. Geographic information system (GIS) has emerged as a powerful tool to analyse wildfire dynamics and inform decision-making. GIS allows researchers and policy makers to visualize wildfire data and overlay it with important geographic information, including land cover, vegetation types and terrain characteristics. This allows for high-risk areas to be identified, resource allocation and targeted mitigation strategies to be developed. The goal of this study is to use Geographic Information Systems (GIS) techniques, as well as administrative boundary data, to gain a better understanding of wildfires caused by humans in Oregon. This research will look at the spatial distribution of wildfires, their timing patterns, and the drivers that cause them. The goal of this research is to provide evidence-based recommendations to help reduce the number and severity of wildfires caused by human activity in Oregon. The goal is to collaborate with government agencies, nonprofit organizations, and community stakeholders to develop evidence-based recommendations for wildfire prevention and management in Oregon (Wimberly, M.C., et al, 2011, Lovreglio, R, et al 2003, Reineking, B, et al.,2010).

2 Literature Review:

Wildfire management challenges and opportunities in Oregon and across the country are outlined in the literature on human caused wildfires and wildfire analysis using GIS. The literature emphasizes the importance of integrating spatial data across multiple disciplines to understand human caused wildfires and their drivers and impacts. For example, research by (Jonathan & Carly. kovacik, 2022) emphasizes the importance of including administrative boundary data in wildfire analysis to gain insight into jurisdictional boundaries and land ownership patterns as well as regulatory framework for wildfire management. In addition, research by (Garcia-Martnz, 2013), and (Kwak, 2009; Bell, & Genton, 2009) demonstrates the usefulness of GIS to identify fire prone areas and (Kwak, 2009). Finally, research by Jacqueline Vaughn (Vaughn, 2020) highlights the importance of community-based wildfire mitigation efforts as well as collaborative partnerships. In addition, studies such as those of ROMERO-CATERRADO and others (Romero-Caterrada, R et al., 2008) and those of Hessburg, (Hessburg 2019, Radelohn, V.C., et al., 2018), show that GIS can be used to evaluate the ecological effects of wildfires, such as habitat destruction, biodiversity. By combining ecological information with wildfire occurrence information, researchers can create spatially specific models to predict how wildfires will behave and evaluate the success of different management approaches. In summary, this literature review emphasizes the importance of using a multi-disciplinary approach for wildfire management, combining GIS techniques with ecological and social science insights. The aim of this study is to synthesize information from the literature in order to develop evidence-based wildfire management strategies that address the specific challenges and opportunities posed by man-made wildfires in the state of Oregon.

3 Methodology:

In order to conduct this study, there are several steps that need to be taken. First, a human-caused wildfire dataset will be created in Oregon. This dataset will include attributes such as the fire name, the year of occurrence, the discovery date, the fire size, and the cause. The dataset will be geo-referenced and overlapped with administrative boundary data. This will allow us to define the occurrence of wildfires within certain jurisdictional boundaries in Oregon. The next step in the analysis will be spatial analysis. This will help us to identify spatial clusters and hotspots, as well as trends in human caused wildfires across Oregon. GIS tools like kernel density estimation (GDI) and hotspot analysis (HOTSPOT) will be used to measure the spatial distribution of the wildfires and evaluate their intensity and frequency across different administrative units. In addition, a temporal analysis will be carried out to look at the timing and seasonality of the human-caused fires over time. The analysis wants so look at trends in wildfire occurrence and seasonality of ignition as w so as the interannual variability of fire activity. Finally, the spatial and temporal analysis will be combined to look at the factors that contribute to the human caused wildfires in Oregon and provide recommendations for the management and prevention of wildfires. By combining GIS techniques and administrative boundary data, the goal of this study is to improve understanding of human caused wildfires in the state of Oregon and provide evidence-based decisions for the management and mitigation of wildfires in Oregon (Barros, Ana M. G., 2021; Jimenez-Ruano, A., et al., 2022; Huang, 2021).

4 Results

4.1 Spatial Distribution of Wildfires by Discovery Data

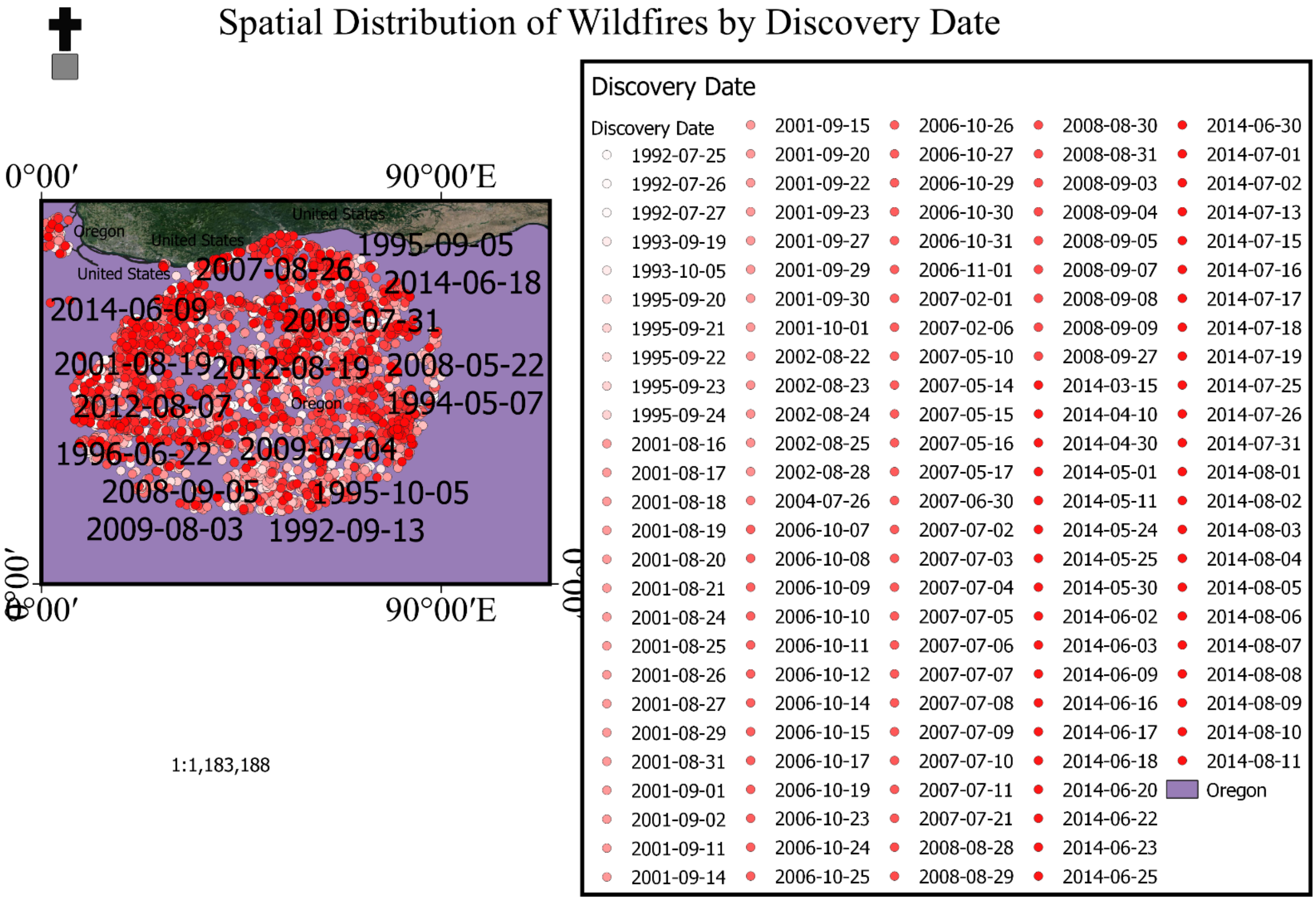

Figure 1. Spatial distribution of Wildfires by discovery date

4.2 Distribution of Human-Caused wildfires in Oregon by year

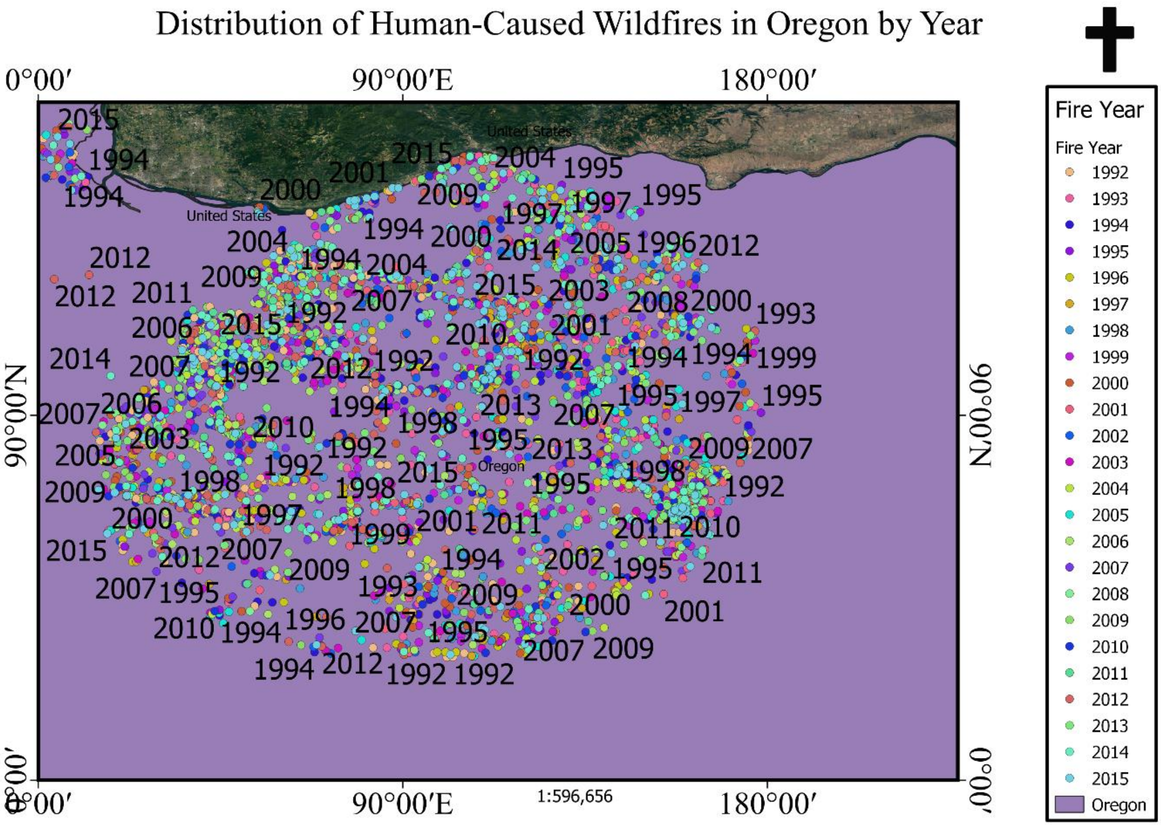

Figure 2. Distribution of human-caused wildfires in Oregon by year

4.3 Wildfire Occurrence by Slope in Oregon

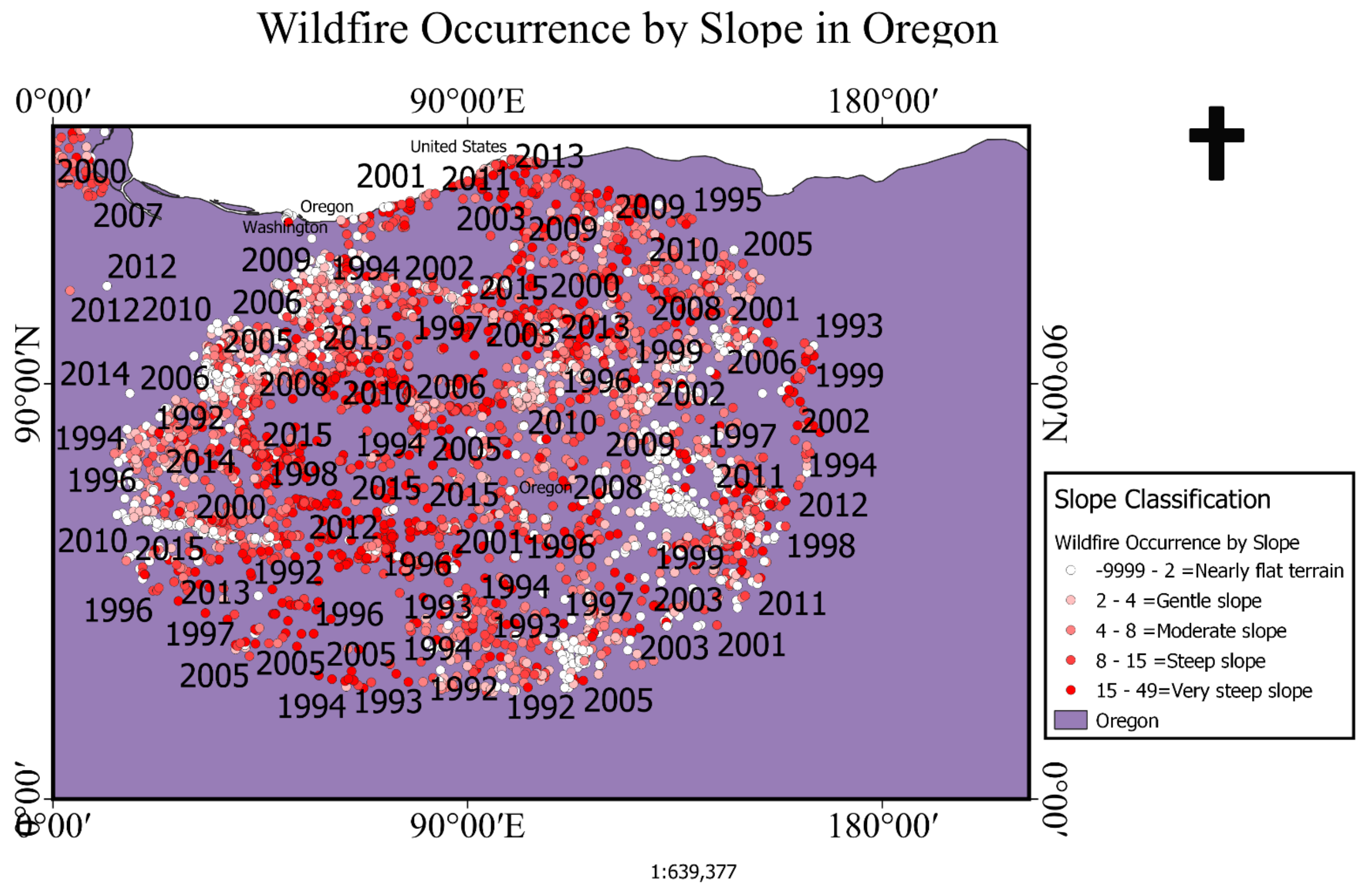

Figure 3. Shows wildfire occurrence by slope in Oregon

4.3.1 Wildfire Occurrence by Elevation in Oregon

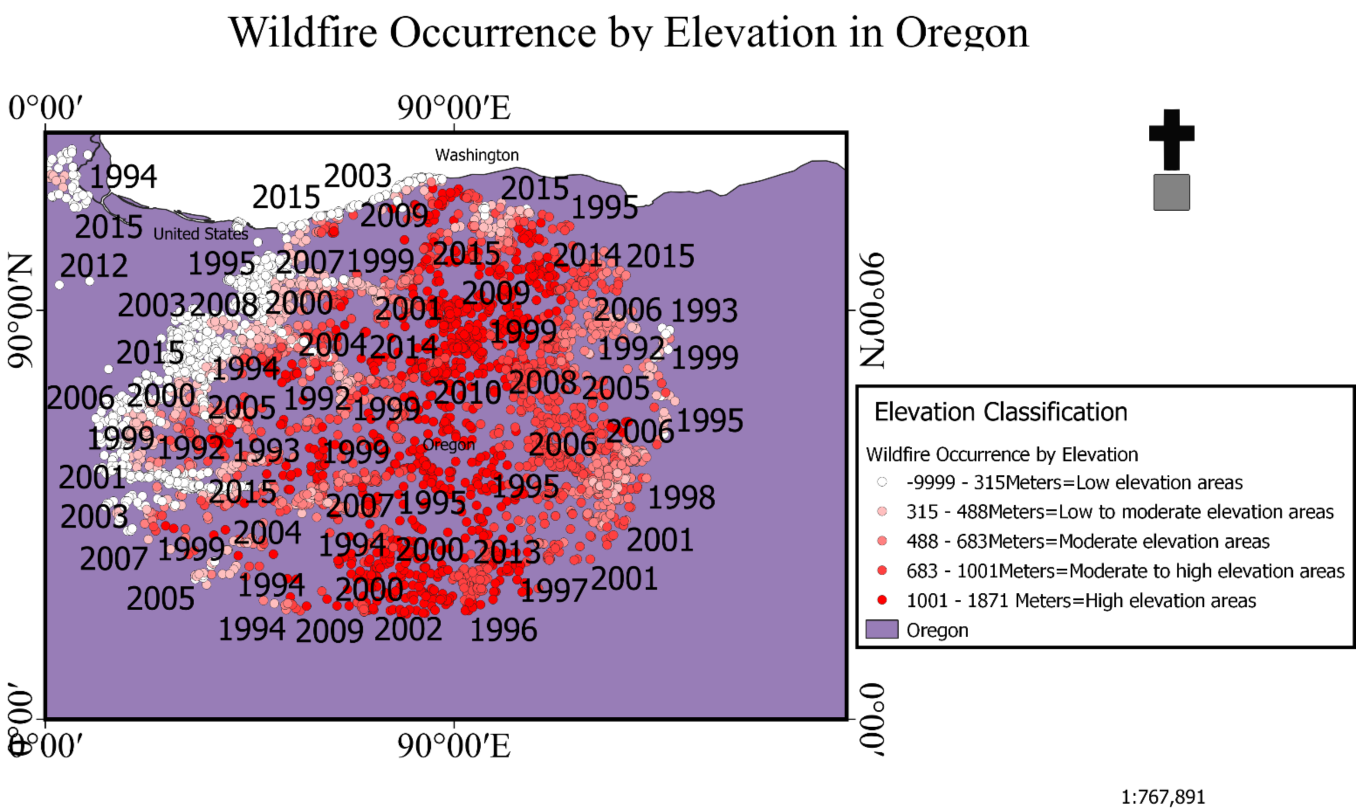

Figure 4. Wildfire Occurrence by Elevation in Oregon

4.3.2 Wildfire Occurrence by Crown Heigh Categories in Oregon

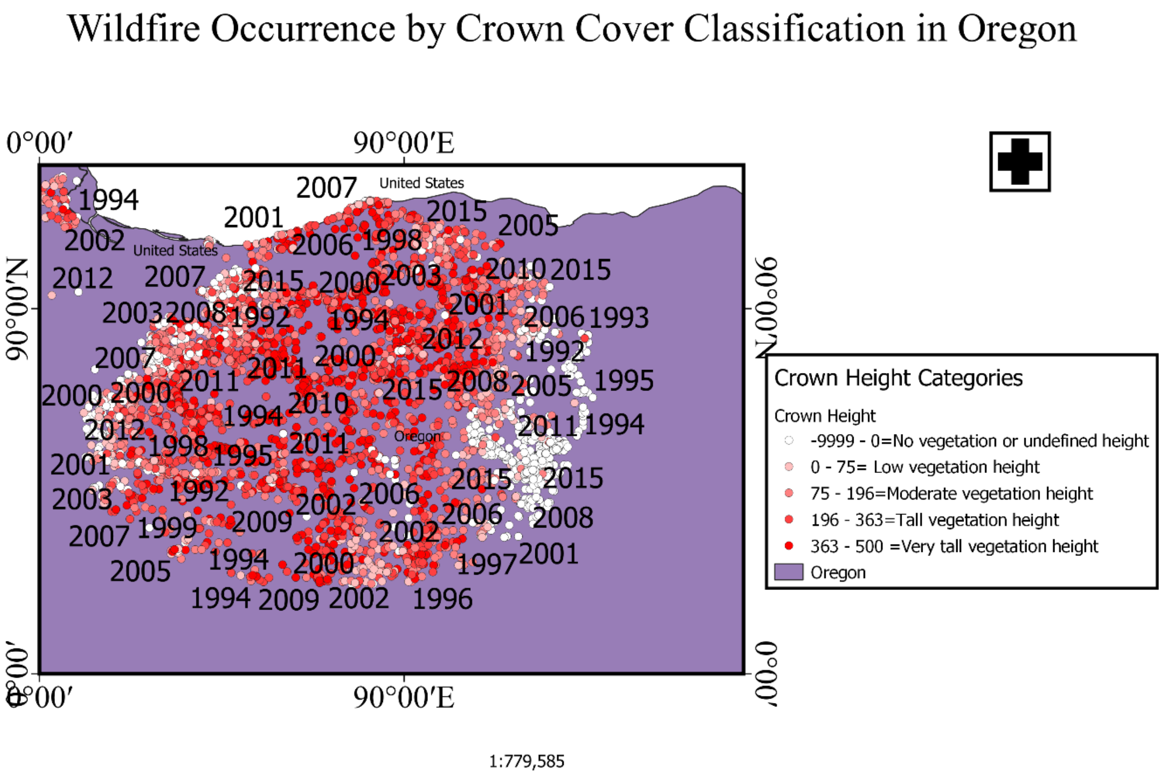

Figure 5. Wildfire occurrence by Crown Cover classification in Oregon.

4.3.3 Wildfire Occurrence by Crown Density with fire year labels in Oregon

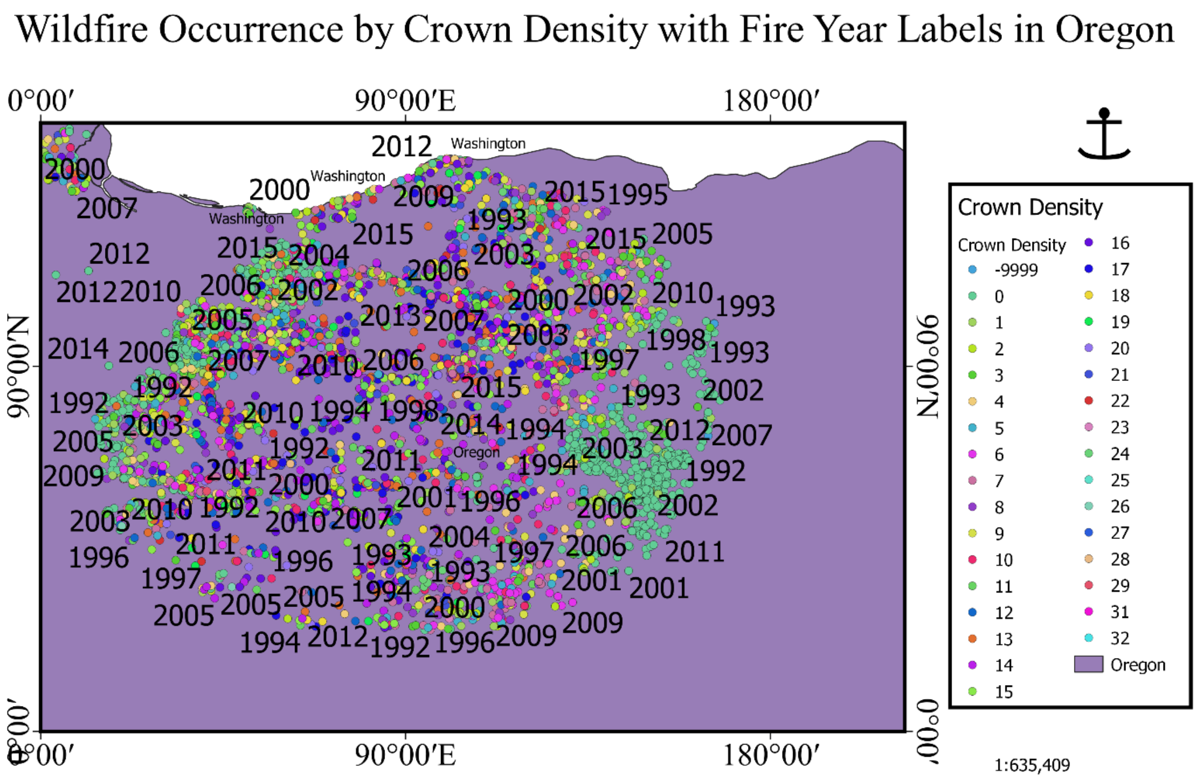

Figure 6. Wildfire occurrence by Crown Density with fire year labels.

4.5 Wildfire Occurrence by Fire Year and Vegetation Type in Oregon

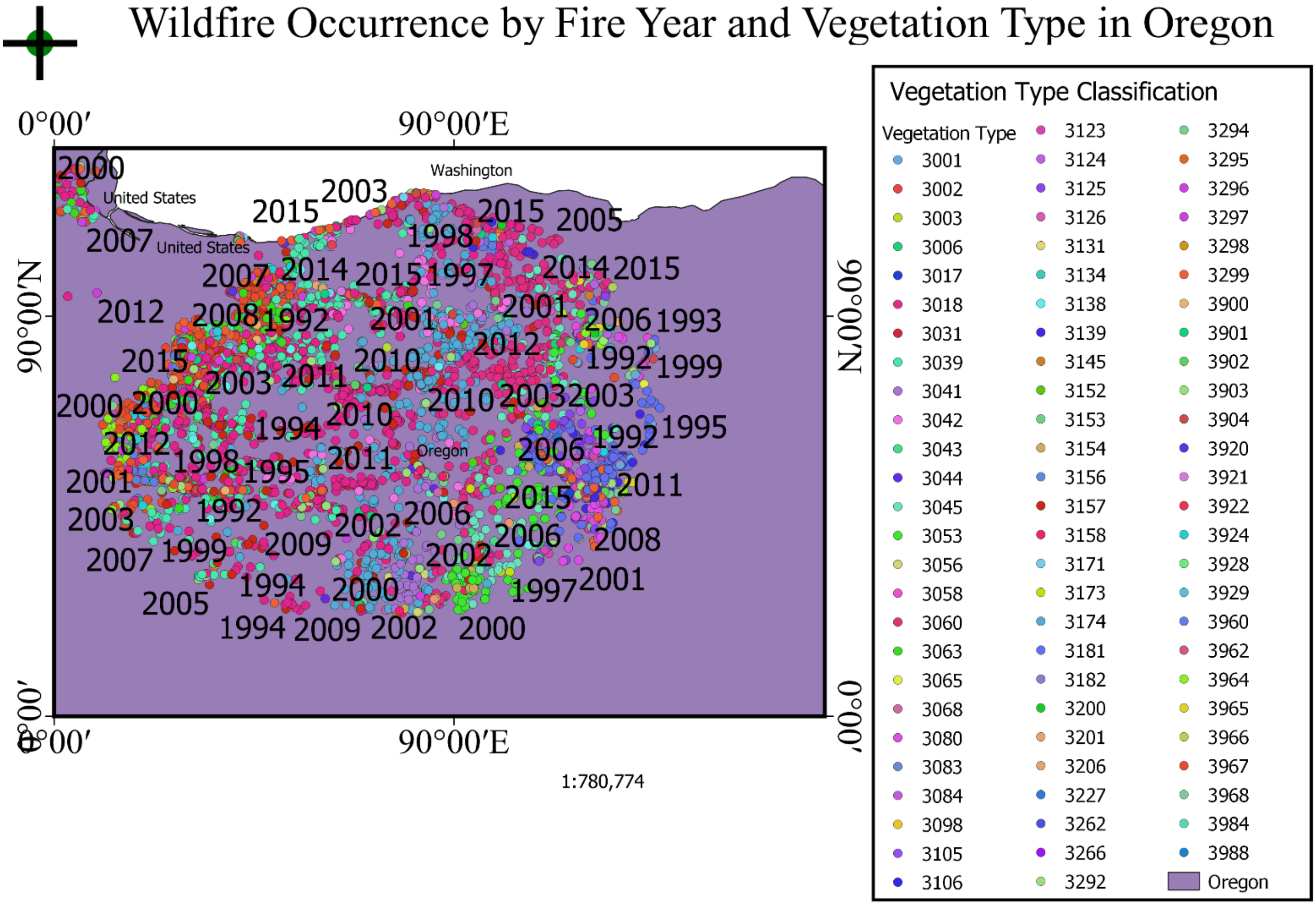

Figure 7. Wildfire Occurrence by Fire Year and Vegetation type in Oregon.

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4.6 Wildfires in Oregon by Size and Name

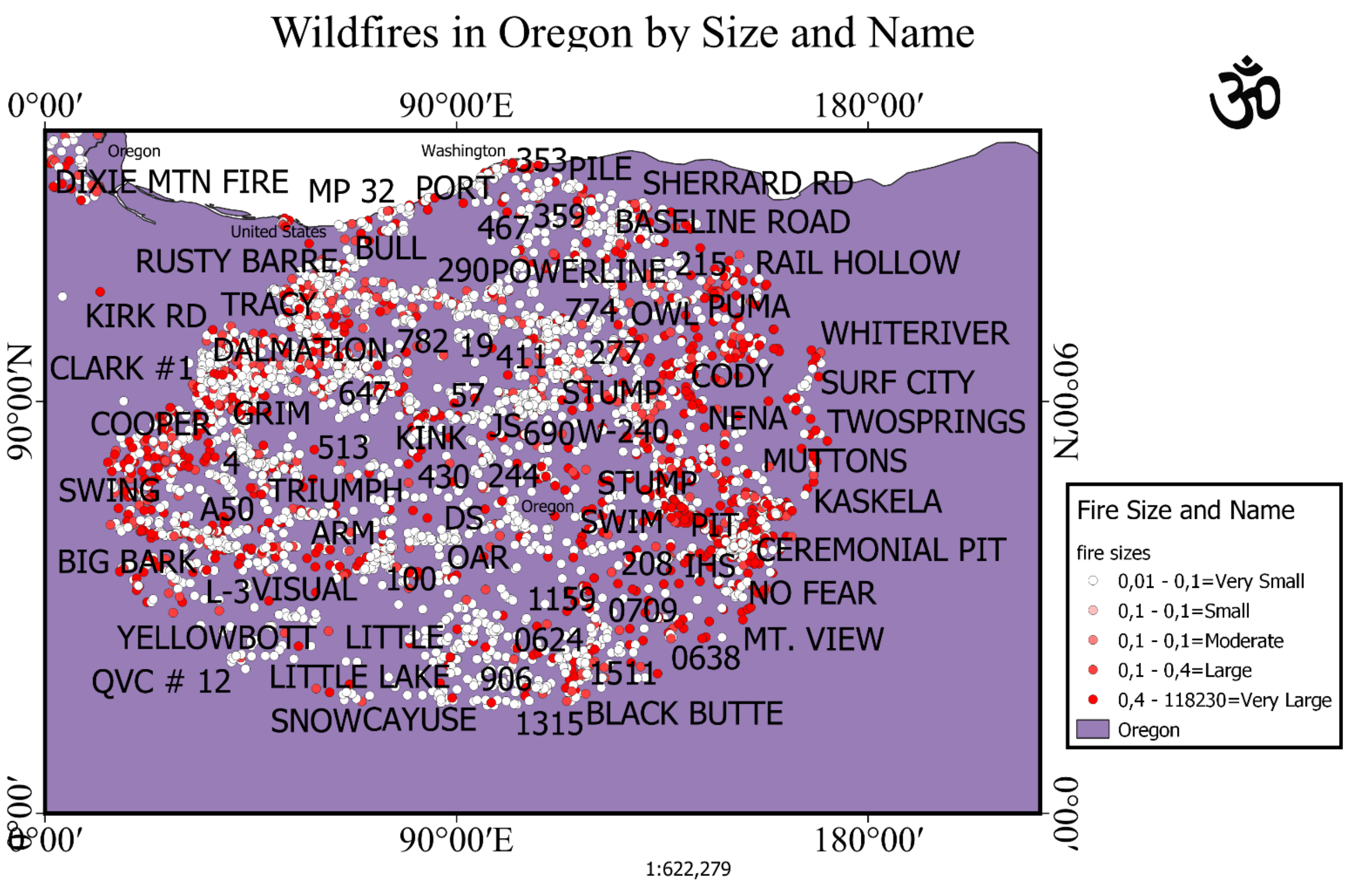

Figure 8. Wildfires in Oregon by Size and Names.

4.7 Wildfire Occurrence by Status Cause in Oregon

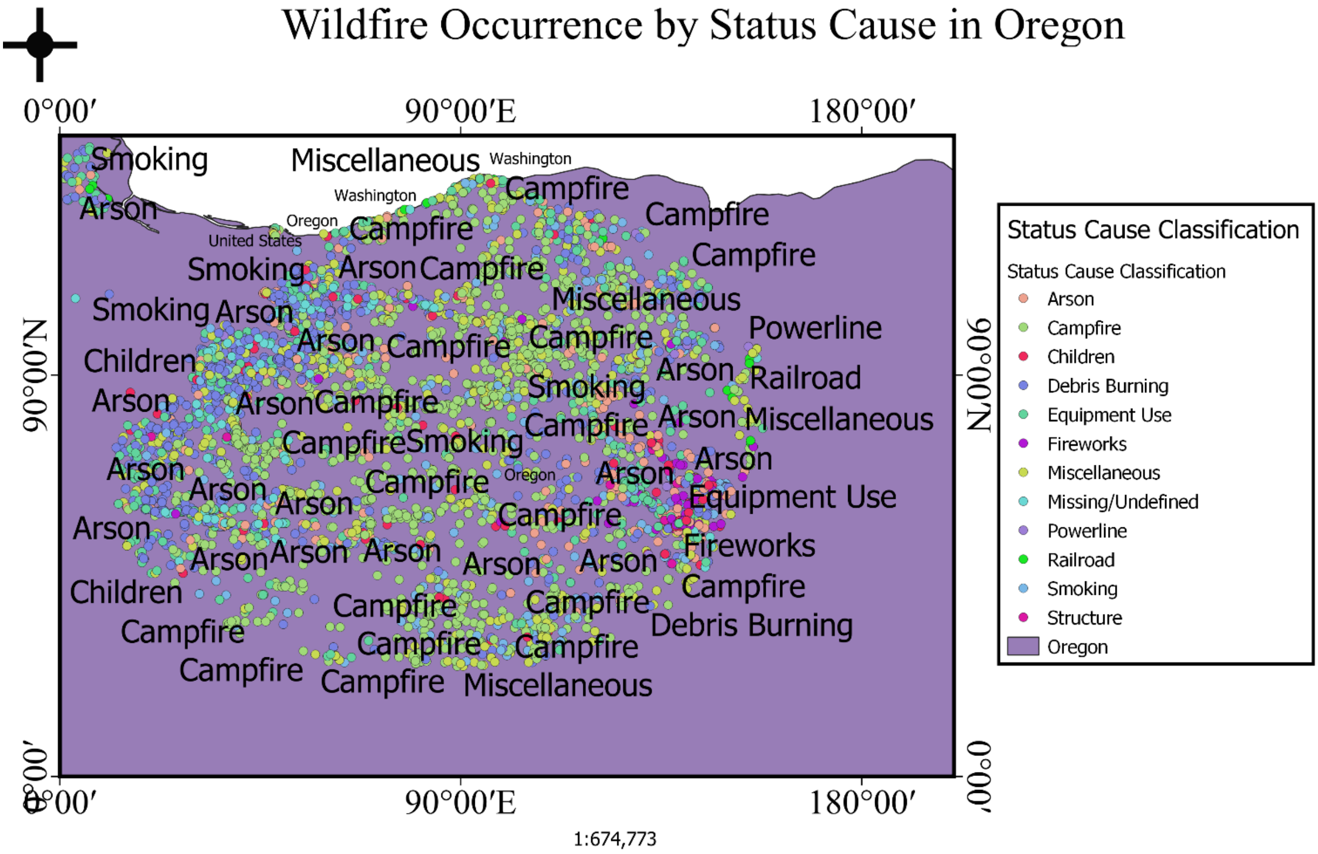

Figure 9. Wildfire Occurrence by Status Cause in Oregon.

4.8 Wildfire Occurrence by Crown cover with Year Labels in Oregon

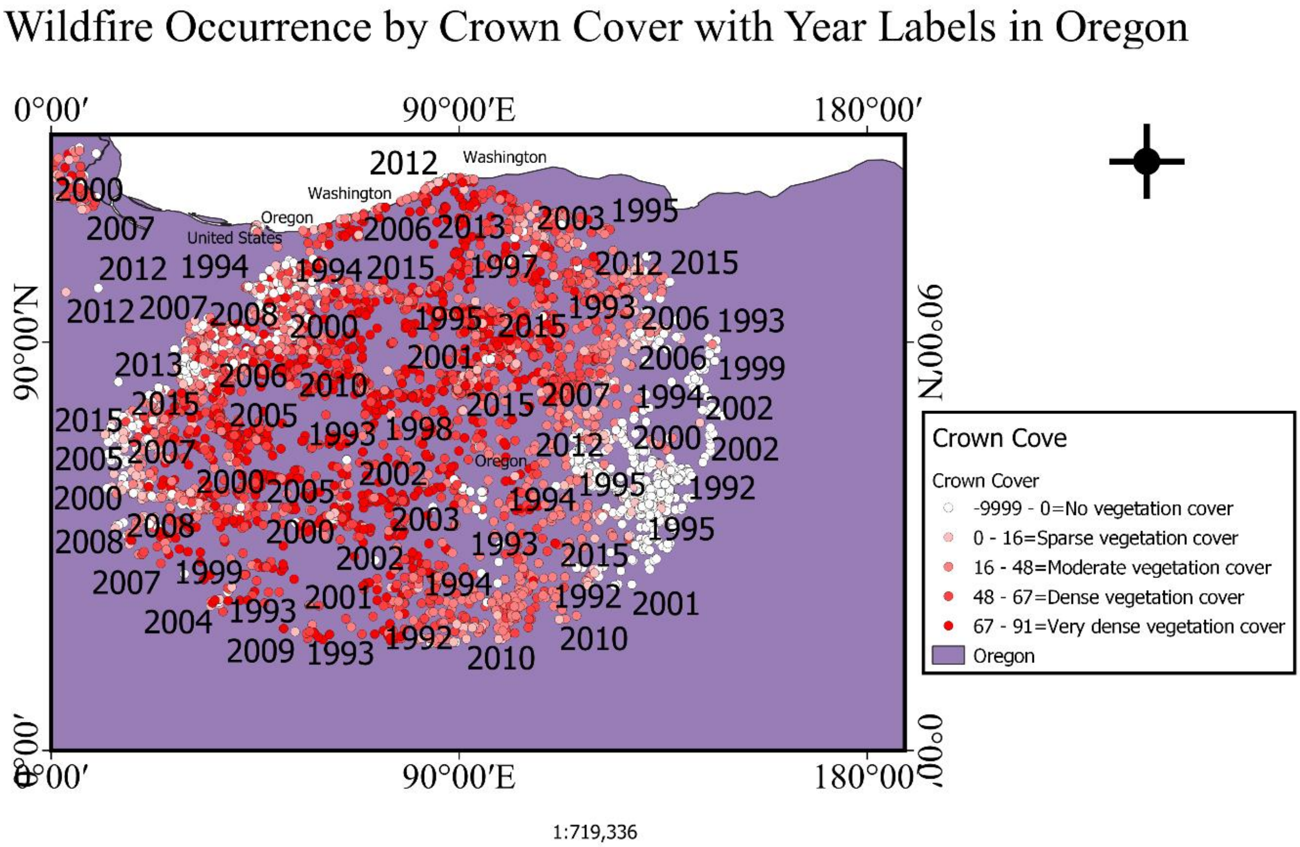

Figure 10. Wildfires occurrence by Crown Cover with year labels.

4.9 Wildfire Occurrence by Crown Density with Fire Year Labels in Oregon

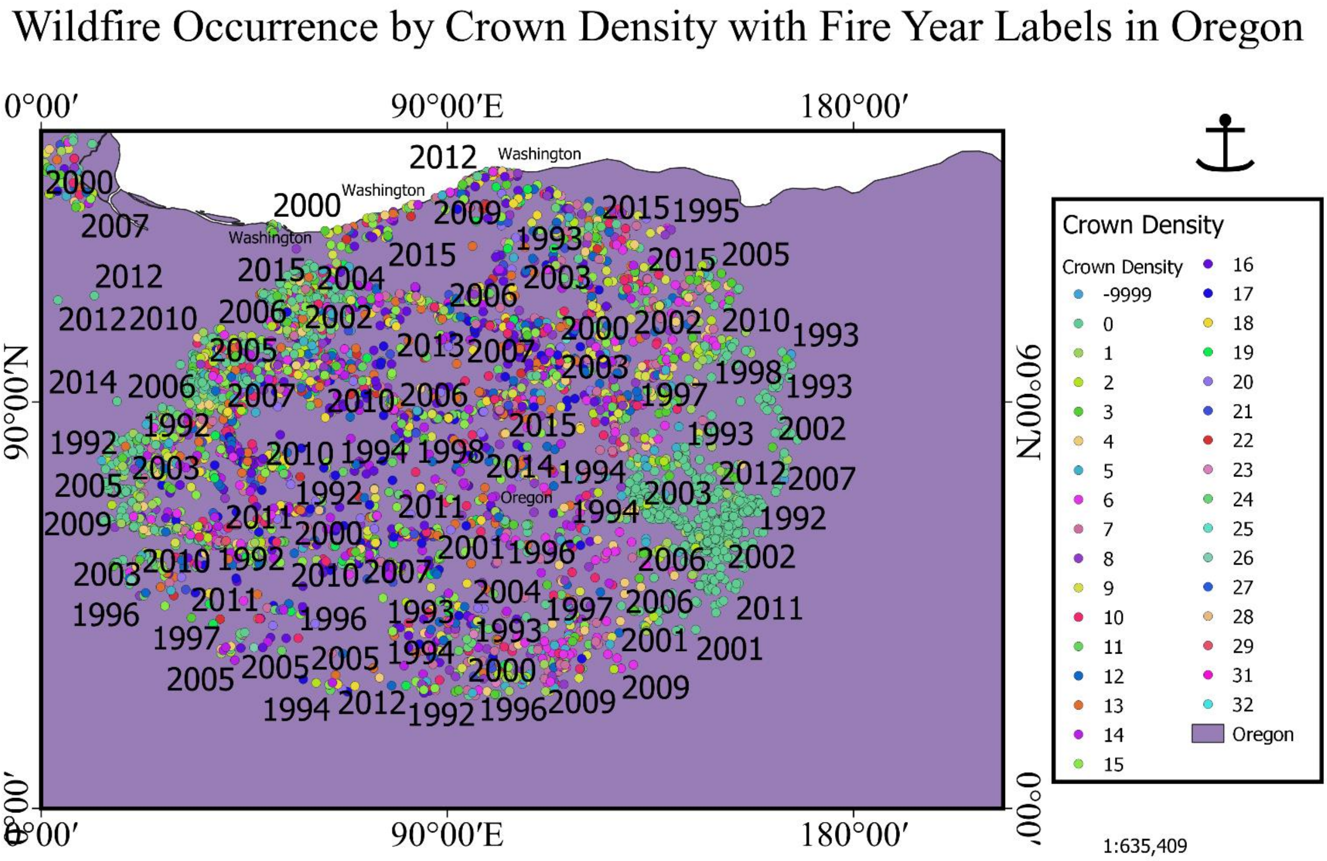

Figure 11. Wildfire Occurrence by Crown Density with Fire Year Labels.

4.10 Wildfire Occurrence by Base Height in Oregon with year labelled

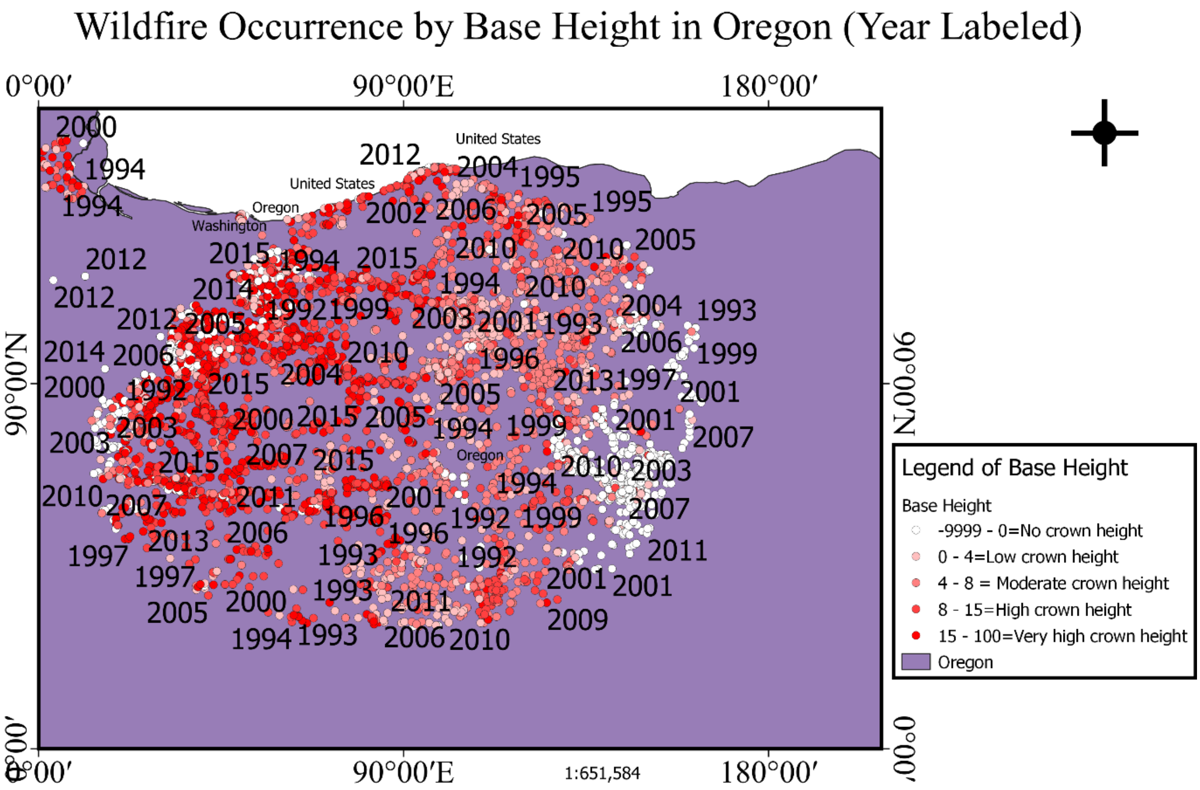

Figure 12. Wildfire Occurrence by Base Height in Oregon.

5 Discussion

The spatial analysis provides important information on the distribution and features of man-caused fires in Oregon. Figure 1 shows the time distribution of wildfires based on discovery date (July 25, 1992-June 30, 2014). This temporal distribution highlights the region's long history of wildfires. Figure 2 shows the distribution of humans-caused fires by year, highlighting variations in wildfire activity over time. The data range from 1992-2015, showing variations in wildfire activity driven by climatological, environmental and anthropogenic drivers. Figure 3 shows the relationship between wildfires and various landscape features. Figure 4 shows the relationship between slope and elevation. Very steep slopes and higher elevation areas contribute significantly to wildfire occurrence. The highest occurrence of ignition events is found in areas with steep slopes and very high elevation. These findings are consistent with previous research showing that terrain plays a significant role in fire behaviour and propagation. Moreover, Figures 5 and 6 provide insights into the relationship between wildfire occurrence and crown cover characteristics. The data indicate that areas with dense vegetation cover and high crown density are more susceptible to wildfires, with very high vegetation height and crown density exceeding 15 being particularly prone to ignition. These findings underscore the importance of vegetation management and fuel reduction strategies in mitigating wildfire risk (G. Woolford, D., et al., 2021). Figures 7 and 8 look at the relationship between wildfire occurrence, vegetation type, and fire size. They show a wide variety of vegetation types that contribute to wildfires. Large and very large fires are the most common. They also show several wildfire incidents by name, showing the scale and impact events have on communities and ecosystems. Large-scale wildfires highlight the need for efficient fire suppression and management (Vaughn 2020). Figures 9 and 10 look at the causes of wildfires, and their relationship to crown cover. They show that campfires and arson are the main ignition sources, showing the role of human activity in wildfire occurrence. They also show that areas with very thick vegetation cover are high-risk for wildfires, highlighting the need for land management practices and community awareness campaigns to reduce human-caused ignition.

6 Conclusion

In conclusion, the findings of this investigation offer valuable insights into the spatial and temporal dynamics of anthropogenic wildfires in Oregon, United States. The examination emphasizes the intricate interplay among environmental, climatic, and human-induced factors that influence the incidence and behaviour of wildfires. Through the utilization of Geographic Information System (GIS) methodologies and administrative demarcation data, this study contributes to a holistic comprehension of wildfire trends and risk determinants, thereby guiding evidence-based strategies for wildfire management and prevention. The outcomes emphasize the necessity for proactive actions to alleviate the consequences of human-caused wildfires, encompassing specific land management interventions, community-cantered wildfire prevention campaigns, and strengthened regulatory compliance. Collaborative endeavours involving governmental bodies, non-governmental organizations, and local communities are imperative for the implementation of successful wildfire management approaches and the enhancement of resilience in fire-prone areas. Advancing into the future, additional investigation is necessary to evaluate the efficacy of wildfire control measures and to examine new patterns in wildfire occurrence amidst evolving environmental circumstances. Through the progression of our comprehension of wildfire behaviours and susceptibilities, we can improve readiness, response, and recovery endeavours, ultimately diminishing the threat of disastrous wildfire incidents and protecting ecosystems and livelihoods not only in Oregon but also beyond (Salguero, J. et al, 2020).

7 References

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